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EXPEDITION OF THE CALIFORNIA ACADEMY OF  
SCIENCES TO THE GALAPAGOS  
ISLANDS, 1905-1906

III  
THE BUTTERFLIES AND HAWK-MOTHS OF THE  
GALAPAGOS ISLANDS<sup>1</sup>

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<sup>1</sup> Unless otherwise stated all the specimens collected on this expedition are in the collection of the California Academy of Sciences, at San Francisco.

## INTRODUCTION

The author regrets that he is unable to include in this paper all the species of Lepidoptera collected on the islands, for while this order is scantily represented in the region under consideration, the smaller and less conspicuous forms present difficulties which would cause considerable delay; and rather than to permit this, he has deemed it advisable to publish at present the butterflies and Sphinges with such observations on other Galapagos Lepidoptera as may assist in showing the facies of this fauna and in rendering an explanation of its origin and development.

A single fauna need not be treated in its entirety to show its relationships with others, though where possible, the whole fauna should be studied.

The Galapagos Archipelago (belonging to Ecuador) is situated on the equator, about 600 miles from the west coast of South America, and a little more than 700 miles from Veragua, with Cocos and Malpelo Islands intervening. This group is therefore considerably closer to the mainland than are some other oceanic islands, as the Hawaiian Islands, 2350 m.; St. Helena, 1100 m.; the Azores, about 900 m.; and the Bermudas, about 700<sup>1</sup> m. I have considered the Galapagos as oceanic as regards their natural history; whether they issued in the first place from the bed of the ocean, or whether they were of continental origin, provided they were once completely submerged,<sup>2</sup> or all living organisms thereon otherwise totally destroyed simultaneously by volcanic activity, as the flora and fauna would still be of oceanic character, *i. e.*, transported across water to the islands, a condition that the writer believes has happened. To quote Wallace in his "Island Life," the Galapagos Archipelago "occupies a space of about 300 by 200 miles. It consists of five large and twelve small islands; the largest (Albemarle Island) being about eighty miles long and of very

<sup>1</sup> These figures are taken from Wallace's "Island Life." According to F. M. Jones (Ent. News XXI, 165, 1910), the Bermudas are 575 nautical miles from Cape Hatteras, North Carolina.

<sup>2</sup> There is good evidence that the Galapagos Archipelago was once one large island which by subsidence has formed the many smaller islands. This view makes it easier for us to explain the existence on all or most of the islands of closely allied species or varieties.

irregular shape, while the four next in importance—Chatham, Indefatigable, James, and Narborough Islands, are each about twenty-five or thirty miles long, and of a rounded or elongate form—these are situated in a comparatively calm sea, where storms are of rare occurrence, and even strong winds almost unknown. They are traversed by ocean currents which are strong and constant, flowing towards the northwest from the coast of Peru.” This, a portion of the great antarctic drift, has the effect of making the climate of these islands, tropically situated, quite temperate. Seldom indeed, then, is the heat excessive, and it appears never to become really cold during any period of the year. The northern extremity of the group is influenced somewhat by the Panama current, so that it is noticeably warmer there than farther south, though the natural history does not appear to be modified in any manner thereby.

Lava of various ages occurs on all the islands, and forms at least their exterior surface in a large measure. Narborough, for instance, is covered almost entirely, from its huge crater over 4000 feet high to the very sea-level, with a layer of recent lava. Only here and there along its sides and base and perhaps summit exist strips or patches of older layers, supporting a meager flora and fauna. All the larger islands, especially Albemarle, have great fields of lava. Charles and Chatham, two of the more southern islands, could be, and are sometimes considered (as regards external appearance) as the oldest islands of the group. They have plenty of good rich soil and their various craters are well rounded and sometimes almost obliterated. The upper areas of the higher islands, especially on their weather side (S. E. in this case) where the moisture first strikes them, have an abundance of humus and vegetation. With a few exceptions, the lowlands are quite arid and of desert character.

For some hundreds of years, the Galapagos Islands have been visited by various ships and were formerly a favorite resort of the buccaneers who were numerous in the region.

In 1835, the Galapagos were visited by Charles Darwin in the “Beagle”; in 1852, by Prof. N. J. Andersson, in the Swedish frigate “Eugenie”; in 1868-9, by Dr. A. Habel; in 1871, by Prof. A. Agassiz of the “Hassler Expedition”; in 1875, by

Dr. Theodor Wolf, State Geologist of Ecuador, and by Commander Cookson of the "Petrel"; in 1884, by Lieutenants Chierca and Marcacci; in 1888, by L. A. Lee of the "Albatross Expedition"; in 1891, by Prof. A. Agassiz on the "Albatross," also by Prof. Geo. Bauer and his assistant; in 1898-99, by Messrs. Snodgrass and Heller of the Hopkins-Stanford Expedition; and finally in 1905-06, by the Expedition of the California Academy of Sciences. The last expedition had, besides the navigator and the first mate and steward, a staff of eight men representing the departments of Zoology, Entomology, Conchology, Botany, Geology and Palaeontology. A full year, of the seventeen months of the Expedition, was spent in the Archipelago, and although much time was lost by reason of the little two-masted schooner "Academy" drifting about the Pacific in calm weather, all the islands and many of the "mere rocks" of the group were visited at least once, and a number, several times, and from different points and during various seasons. Thus the Expedition, equipped for the special purpose of studying and collecting specimens of natural history, was able to bring together a far larger and more varied assemblage of specimens than was collected perhaps by the sum total of all the previous expeditions to these islands. It is only fair to bear in mind, however, that a number of the earlier expeditions were handicapped by lack of time, equipment, and sufficient and capable collectors; nevertheless, the results of their labors are very creditable when we consider the paucity of the Galapagos fauna, the general rough character of the country, and the fact that in some cases, the collecting and studying of specimens of natural history was but a secondary or incidental matter.

The zonal divisions of the fauna and flora of the Archipelago are very interesting. The plant zones on the windward (S. E.) side of the more lofty islands are often quite distinctly defined and can be observed from several miles at sea. The Zoological regions conform in a greater or less degree to those of the flora. The south and southeast sides of Indefatigable Island, show these zones very nicely,<sup>1</sup> and a brief discourse on them will give

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<sup>1</sup> While the zones may be distinct on the weather side of an island, the opposite or dry side of the latter displays no such well-defined areas, hence the arid belt *de natura* extends much higher up on that side, while the humid areas are forced far up the slopes and are of quite limited extent, if at all present.



the reader an idea of their character (Plate XXI). The upper or humid portion of the island (500 feet and up) is very difficult of access owing to the dense tangle of vines and scarcity of water. The island was not explored above 1000 feet altitude, therefore the character of the vegetation above about 1400 feet was not satisfactorily ascertained, but by means of observations through binoculars and by observing the slopes and summits of other high and more accessible islands of the group, a doubtful idea of the "Brown Zone" was obtained.<sup>1</sup> Indefatigable Island is about twenty-five miles in diameter and nearly circular in outline, and is situated a little south of the center of the main Archipelago. Its height is estimated at a little over 2200 feet, but it appears fully 3000 feet high. The slope from shore to summit is very gradual and comparatively uniform, and the lower or arid area of much greater extent than the more elevated humid regions. The summit of Indefatigable Island probably contains a large crater. This portion of the island is very commonly enveloped in clouds. The two well-defined life areas, the arid and the humid, can each be subdivided into regions of a less distinct character, and the former are connected with each other by a species of transition or "Big Tree" zone which has a lighter green appearance than the "Green" zone above it.

Commencing at the shore line, we find the "Arid" zone skirted by a littoral flora composed largely of such trees as *Rhizophora mangle*,<sup>2</sup> *Avicennia officinalis*, *Hibiscus tiliaceus*, the poisonous *Hippomane mancinella*, and the stout creeping vine, *Ipomoea pes-capræ*. Usually the above mentioned plants do not occur inland any distance, except sometimes about bodies of water.

Proceeding towards the interior of the island, one passes through nearly two miles of rough desert-like country where there is but little soil but an abundance of lava. Here the two genera of *Cactaceæ* (*Cereus* and *Opuntia*), *Croton scouleri*,

<sup>1</sup> Indefatigable Island has been selected for the illustration of the zones on account of the well-defined appearance of the latter there. It must be borne in mind that elsewhere in the Archipelago, they are on the whole, far less distinct.

<sup>2</sup> I am indebted to Mr. Alban Stewart, botanist to the expedition, for a number of the botanical names given in this paper. In the proceedings of the California Academy of Sciences, Vol. I, 4th Ser., pp. 206-211, Mr. Stewart gives the botanical regions and zonal elevations more in detail.

the majority of the *Acaciæ*, *Gossypium*, *Cordia lutea*, etc., occur plentifully, sometimes forming thickets. Roughly estimated, this zone extends to a height of about 200 feet where it merges into the "Big Tree" zone, in which we find the handsome Guava tree (*Psidium galapageium*), *Pisonia floribunda*, and one or two others. Here is a thin covering of soil, small ferns cover the rocks, and the country loses a great deal of its desert aspect. This zone is somewhat ill-defined as to its lower limits. From the "Big Tree" zone, one enters quite abruptly into the "Dark Green" or really humid zone where the soil is rich and the conspicuous vegetation made up in large part of delicate ferns, several species of *Convolvulacæ* among the vines, and *Scalesia pedunculata*, a tall composite of graceful form. The growth here is really luxuriant, and being composed of matted vines and some shrubs (the mass reaching a height of about eight feet), it is nearly impenetrable without the aid of a machete. Every now and then, a pretty little grove of tall Cannas is met with; going higher up, the *Scalesia* thins out and the dreary slope presents a rather gloomy appearance. This is a very extensive zone, reaching from 400 or 450 feet to far up the mountain. Above this to the summit, the slope appears equally or more impenetrable, but the color of the above "Brown Zone" suggests lichen-covered trees, taller ferns, with perhaps here and there an open grassy space. Above 400 or 500 feet, there is much humidity and the precipitation must be considerable throughout the year.

The rainy season which lasts from about December to about April, has the effect of making the lower zones fresh and verdant for a short period, and of awakening the insect life which lies dormant there. A little while after the commencement of the rainy season (at which time it is a little warmer), insects appear in comparative abundance; and various shrubs and vines support large numbers of Lepidopterous larvæ, principally *Sphingidæ* and *Noctuidæ*, which though not of many species, are conspicuous by reason of their abundance. At the same time, the enemies of these insects appear. The large greenish *Calosomas* (*Calosoma Howardi*, Linell), search the bushes diligently for larvæ, and do not hesitate to attack and overcome large Sphingid caterpillars. The giant centipedes

(*Scolopendra*) some  $9\frac{1}{2}$  inches long, must also destroy numbers of the larvæ.

By the month of May or June, the lower levels resume their desert aspect and insect life is largely dormant. The upper regions however, enjoy a more continued rainfall and have seasons that are necessarily more continuous, so that in the late months of the year, insects do not appear to be much diminished in numbers. There are certain portions of the lower levels, especially about the brackish bodies of water at sea level, which are not sufficiently affected by the rainless season to be unproductive at that time of the year.

From observations and by deduction from the seasonal table of Rhopalocera (at the end of this paper), I have arrived at the conclusion that from the middle of February to the middle of March, is the height of the season for adults, in those regions at least which are influenced by the seasonal rains, *i. e.*, the lower areas; while above in the mountains, as heretofore stated, the seasons are not well marked, for insects in general appear more or less continuously.

On the whole, the lower zones seem richer in insect life, the densely verdant portions of the islands not yielding very much entomologically, but the more open summits of some of the islands support a good variety of insect life. The tall graceful *Scalesia* growing in the humid regions, supports quite a beetle fauna, as do the various *Acaciæ*, the *Crotons*, and the *Bursera* of the "Arid" zone. Inasmuch, however, as a single insect will sometimes feed on one species of plant in the dry zone and upon another in the humid, as often happens, it results that the ranges of such insects are more extensive than that of the flora. Other insects which do not appear to be directly dependent upon the flora, are nevertheless confined to a well-defined area. This is true of some of the species of the littoral or coast fauna. The climate of the Galapagos is not really tropical (as regards rainfall, heavy atmosphere, etc.), neither is the insect fauna typically tropical; and this is probably also true to a degree with regard to the rest of the fauna as well as the flora.

If we compare the Galapagos Islands with the small but beautiful Cocos Island lying several degrees to the northeast,

it will be found that though the latter is in warmer waters than the Galapagos and much nearer the mainland, the insect fauna of this little island although quite meager, is of a distinctly more tropical aspect. The island is covered with good-sized trees festooned with vines, and apparently possesses a few clear areas. The climate is warm, the atmosphere heavy, and there is water everywhere in the form of creeks and cascades, but dense forests do not support a rich insect fauna. Only two species of butterflies were taken on Cocos Island, and neither of them occur in the Galapagos. One is an *Aganisthos* (probably *odius*), the other is a species of delicate build which has not yet been determined. Two Sphingides were seen there, one the wide-spread *Phleg. cingulata*, the other which was not taken, suggested the large *Pachylia ficus*.

The butterflies of the Galapagos Archipelago number six species, two of which were taken for the first time on this expedition. These latter species are *Pyrameis huntera* and *caryæ*. Both are rare in the islands. The *Sphingidæ* number eight, two, *Triptogon lugubris* and *Theretra tersa*, are here reported for the first time from the islands, the former species being plentiful, the latter rare.

## RHOPALOCERA

- Callidryas eubule, Linn.
- Agraulis vanillæ, Linn. var. Galapagensis, Holland.
- Pyrameis huntera, Fabr.
- Pyrameis caryæ, Hubner.
- Cupido parrhasioides, Wallengren.
- Eudamus galapagensis, N. Sp. (Williams).

## PIERIDAE

1. *Callidryas eubule* Linn. Syst. Nat., p. 743, 1766. Holland. Proc. U. S. N. M., XII, 195, 1889.

Holland (Proc. U. S. N. M., XII, 195, 1889), says: "Differs in no respect from the forms taken commonly in the Southern United States and West Indies." The Galapagos specimens are certainly more referable to the form *sennæ* as described by William H. Edwards (Trans. Am. Ent. Soc. IX, 9, 1881), being "generally smaller than *eubule*," the ♀ having

the deeper color of the *sennæ*. There are a number of *Callidryas* from the Galapagos Islands in the Leland Stanford University Collection, including sixteen ♀♀. Mr. E. J. Newcomer has kindly examined these specimens for me and is of the opinion that all the ♀♀ are *sennæ*, as probably also the ♂♂. The insects, as can be seen from the measurements below, average considerably smaller than those from Southern California and some other portions of the United States, and some of the small specimens seem to indicate the dwarfing effects of the arid regions of the islands. *Sennæ* according to Edwards, inhabits Brazil, Central America, Mexico, Texas, Jamaica, Hayti, etc., and is taken in Southern California. Following the smaller size of the Galapagos *Callidryas*, is the blunter apex of the primaries and inner angle of the secondaries.

*Eubule* is an abundant insect and the most conspicuous butterfly of the Archipelago, having about the same distribution as *Agraulis vanillæ galapagensis*, and in favorable years, is probably to be found on all but the two northern islets, Wenman and Culpepper, and the other mere rocks. It occurs abundantly at moderate and low altitudes, and is rarer on summits. From February to April, 1906, it was plentiful in the vicinity of Wreck Bay, Chatham Island, and on Albemarle in the vicinity of the Villamil settlement, where it was sometimes seen gathered in numbers about cattle droppings. At Tagus Cove (Albemarle), it was common during March and April, especially at the yellow flowers of *Cordia lutea* and *Gossypium* Sp., resting on the blossoms of the latter in dull weather. At Bank's Bay (Albemarle), in April, they were observed feeding at the flowers of *Opuntia* growing near the seashore.

The season for adults ended in general, in May, at the lower levels. During early October however, the insect was abundant at 1000 feet elevation; a few were seen during the same month on Charles Island in the dry zone, and in the "Green Zone" on South Albemarle.<sup>1</sup>

<sup>1</sup> I have noticed that the Galapagos *eubule* do not possess as strong or rapid a flight as those found on the mainland, where I have observed them in Lower California and in Kansas, and this inferiority in flight is quite striking.



But little of the early stages were noted. Oct. 15, 1905, a ♀ was observed ovipositing on the legume *Cassia picta*, and several half-grown larvæ were found feeding on the same plant in the "Green Zone," of South Albemarle, in early September, 1906. Occurs on Charles, Chatham, Indefatigable, Albemarle, James, Narborough, Abingdon Islands, and probably on Hood, Duncan, Bindloe, Jervis, and Barrington Islands.

Taken also on the Albatross Expeditions in 1888 and 1891 (where it is referred to by Agassiz as *Colias*<sup>1</sup>), Hopkins-Stanford Expedition, and perhaps also on some of the earlier expeditions.

Alar expanse: ♂ 44, 44, 51, 56, 56, 56, 56, 58, 60, 62, 64, 64, 64, 65, 66, 66, 67, 67, 70, 72 mm.=60.6 mm.

♀ 38, 60, 61, 63, 70 mm.=58.4 mm.

26 specimens.

## NYMPHALIDAE

2. *Agraulis vanillae* Linn., Syst. Nat., 482, 1758, var. *Galapagensis*, Holland., Proc., U. S. Nat. Mus. XII, 194-5, 1889.

Holland's description reads: "The form of *A. vanillae* in the collection ticketed 'Chatham Island' differs in some respects so decidedly from the typical form as to well deserve a varietal name. It is characterized by its smaller size, by the darker and more fuscous tint of the basal half of the wings, by the great increase in breadth of all the black markings on both surfaces, and the almost entire obliteration of the white dots by which the spots in the cell on the upper surface of the primaries are pupiled in typical specimens. One specimen, Galapagos, Chatham Islands."

It is therefore quite a different appearing insect from typical *A. vanillae* and might rightly be raised to specific rank. In *Galapagensis*, the less sinuate outer margin of the primaries (probably resulting from the dwarfing of the insect), gives the latter a much blunter aspect than those of our *A. vanillae*. From Holland's description of the species, I judge the type to be a male. The female varies somewhat in color, for it may be as in typical *vanillae*, darker with heavier black markings

<sup>1</sup> Bull. Mus. Comp. Zool., XXIII, 68, 1892.



and the ground color yellowish beyond the cell of the primaries; or perhaps more commonly the pale yellow color occupies the greater portion of the primaries, becoming darker and mingled with fuscous basally, and at the inner margin; the pattern is as in typical *A. vanillæ* but the markings are a good deal heavier.

*A. vanillæ galapagensis* is a fairly common butterfly, occurring on all the larger islands of the group where it is ordinarily restricted to the dryer levels where its food-plant (*Passiflora*), is to be found. The butterfly flies low and rather slowly and alights but rarely. At Tagus Cove (Albemarle), it was quite plentiful during March and April, both in the valley and on the west slope of the high mountain which was comparatively dry even to its summit, 4000 feet above the sea. In a strip of vegetation at an altitude of 1500 feet where *Passiflora* was abundant, a few larvæ of this butterfly were seen. They were mostly in the final instar, and from them, I succeeded in rearing but one butterfly, the other larvæ perishing before pupation.

The butterfly was observed perhaps most plentifully on the rounded summit of Charles Island (May and June). On this island, during the month of October, 1905, a female was observed ovipositing in the dry thickets, and this would suggest that the species passes the dry season in the egg state or as very young larvæ.<sup>1</sup> Occurs on Charles, Chatham, Indefatigable, Albemarle, James, Narborough, and Abingdon Islands. It may also occur at times, on some of the other islands.

Alar expanse: ♂ 45, 49, 49, 50, 52, 53, 54, 55, 57, 58, 60, 60=53.5 mm.

♀ 48, 52, 52, 54, 55, 55, 55, 56, 60, 61=54.8 mm.

22 specimens. Plate XX, figs. 1-2.

### 3. *Pyrameis huntera* Fabr., Syst. Ent., 499, 1775.

One fresh specimen, taken on the treeless summit of Villamil Mountain, 3000 feet altitude (Albemarle Island), August, 1906. The insect is typical and expands 52 mm. Several

<sup>1</sup> Collected on the Albatross Expedition in 1888 and 1891 (where it is referred to by A. Agassiz as *Argynnis*), the Hopkins-Stanford Expedition, and perhaps also on some of the earlier expeditions.

other rather worn examples were seen flying briskly about the summit, and one or two fresh specimens were observed in late March, 1906, on Tagus Cove Mountain, at an altitude of 3500 feet. At this locality, was found a species of *Gnaphalium* which was without doubt the larval food-plant of *huntera*.

4. *Pyrameis caryæ* Hubner, Samml. ex. Schmett., I, 1806.

One flown example taken at Wreck Bay, Chatham Island, January, 1906. Does not differ from Californian specimens. Several species of *Urticaceæ* and *Malvaceæ* occur in the Galapagos, and on one or more of these the larva must feed.

LYCAENIDAE

5. *Cupido parrhasioides* Wallengren (Lyc. par.). Wein. Ent. Mon. IV, p. 37, No. 15, 1860. Eug. Resa. p. 355 (1861).

This pretty "blue" was described from specimens taken on the voyage of the Swedish frigate "Eugenie," in 1852.

Wallengren's description is as follows<sup>1</sup> (p. 355) 10. *Lycaena parrhasioides*:

"Alis ecanudatis, infra canescentibus lineis albis duplicatis subundulatis, posticarum irregularibus; posticis ocellis 3-4 analibus, nigris coeruleofoetis; oculis hirtis.

*Mas*: Alis supra violaceo-caerulescentibus, posticis punctis 2-3 analibus nigris, sub-obsoleteis.

*Femina*: Alis supra fuscis, ad basin plus minus coerulea-pulverulentibus; anticis macula discoidali fusca, obsoleta; posticis punctis 4 analibus nigris, antice coeruleo-limbatis.

*Patria*: Puna mense Martii. Iusula St. Joseph mense Aprilis; ins. Galapagos mense Maji.

*L. parrhasio*, God. affinis videtur; *L. optileti* magnitudine æqualis, sed interdum *L. also* haud major. §*Mas*: Alæ supra violaceo-coeruleæ, margine exteriore tenuissime infuscato; posticæ puncta 2-3 analia nigra gerunt. Alæ omnes infra canescentes; anticæ per discum lineas subundulatas, transversas 6 albas, per paria sitas, quarum par externum postice abbreviatum, gerunt; alæ posticæ etiam lineas ejusmodi ostendunt, sed par intermedium sæpissime bis interruptum, et externum tantum inter costas 2-6 locum tenet, et cum pari intermedio ad finem tam antice tam postice cohærit. Ad basin alarum posticarum linea albo unica se præbit. Ad marginem exteriorem alarum omnium circuli oblongi et intra illos anguli confluentes albi locum tenet. Circuli 3-4 alarum posticarum anales sunt in medio nigri cæruleo-fœti, ocelliformes. A basi alarum anticarum usque ad medium, prope marginem anticum, striga fusca, postice albo-marginata, locum tenet. Interstitia inter lineas transversa alarum anticarum fundo obscuriora. §*Femina* mari infra similis, supra fusca, et ad finem cellulæ alarum anticarum maculam transversam, fuscam, obsoletam gerit. Alæ ejus omnes sunt supra ad basin cæruleo-pubverulentes et posticæ puncta analia 4 nigra, antice cæruleo-limbata, gerunt."

<sup>1</sup> Furnished me through Dr. Henry Skinner.

The above states that the wings are without tails, below grayish with subundulate, double, white lines, those of the secondaries irregular; secondaries with three to four black anal spots full of blue; eyes hairy.

Male: Wings above violet bluish, the secondaries with from two to three black anal spots, which are sub-obscure.

Female: Wings fuscous above, more or less powdered with blue towards the base, the primaries with the fuscous discoidal spot obscure, secondaries with four black anal spots, bordered anteriorly with blue.

Habitat Puna (March), the island of St. Joseph<sup>1</sup> (April), Galapagos Islands (May).

Related to *L. parrhasio* God. It is equal in size to *L. Optileti*, but now and then it is not larger than *L. Also*.

Male: Wings above violet blue, exterior margin very narrowly infuscated. Secondaries bear two to three black anal points. All the wings beneath are grayish. The primaries are traversed by six white subundulate lines arranged in pairs, the external pair of which is shortened posteriorly; secondaries also have lines of this kind, but the intermediate pair is very often twice interrupted, and the external pair only occupies the space between veins 2-6, and is joined together with the intermediate pair at the end anteriorly as well as posteriorly. There is a single white line at the base of the secondaries. There are oblong circles along the exterior margin of all the wings and within these the space is occupied by confluent white angles. Three to four of the anal circles of the secondaries are ocelliforme, black in the middle, and full of blue. There is a fuscous streak edged posteriorly with white, extending from the base of the primaries up to the middle field, near the front margin. Spaces between the transverse lines of the primaries more obscure at the base.

Female: Similar to the male beneath; above, fuscous, with an obscure transverse, fuscous spot at the end of the cell of the primaries. Above, all the wings of the ♀ are powdered with blue at the base, and the secondaries have four black anal points edged anteriorly with blue.

<sup>1</sup> This must be S. José I., one of the Pearl Islands, in the Bay of Panama.

This species, according to Wallengren, is related to *L. parrhasius* of Java. Its nearest ally and perhaps the one from which it was derived, is probably *Lyc. marina* of America, from which it can be separated by its somewhat smaller size and darker shade, and by the possession on the under side of the secondaries of three (with traces of one or two more) distinct velvety black spots ringed by metallic blue and then by orange, whereas *marina* has but two such spots. The second spot from the anal angle is the largest. The undulating white lines of the wings beneath are finer than in *marina*.

*C. parrhasioides* is common in the Galapagos, where it was found on Charles, Chatham, Albemarle, Narborough, James, Hood, and Duncan Islands. It seems to be more restricted to the arid district than are the other butterflies, and occurs commonly where its food plant, *Cardiospermum corindum* and perhaps *C. galapageium* (*Sapindaceæ*) is found.

Near the shore at Cape Rose (Albemarle Island), in March, 1906, the little butterfly was plentiful in the vast field of jagged black lava which supported a somewhat scant vegetation—*Croton*, *Bursera*, *Opuntia*, *Cereus*, etc., and its vine-like food plant. The butterfly was here observed to oviposit on the young leaves of this plant. At the lower levels, about James Bay (James Island), *parrhasioides* was abundant where *Cardiospermum* flourished, which was especially on lava. The butterflies were at this season (August, 1906), in a generally faded condition, and the egg shells of the species were plentiful on *Cardiospermum*, then in leaf.

As the imagines were fresh and common at a much earlier date than August, we may infer therefrom that *parrhasioides* is double-brooded, the February-March specimens emerging from pupæ formed in about September of the preceding year; or perhaps that the insect passes the dry season as an egg or small caterpillar.

A female *parrhasioides* from Iguana Cove, Albemarle, is aberrant in having the undulating white lines beneath diffusing and disappearing.

The insect was also taken on the voyage of the "Eugenie"; by A. Agassiz in 1891; and by Snodgrass and Heller of the Hopkins-Stanford Expedition. Its occurrence on Puna Island

in the Gulf of Guayaquil (Ecuador), and on St. Joseph Island in the Bay of Panama, is interesting and suggestive. *Sphingonotus fusco-irroratus* (Orthoptera), is also reported from Puna as well as the Galapagos Islands.

25 specimens, including one ♂ sent to Dr. Henry Skinner for his opinion on the species.

♂ 20, 20, 20, 22, 22, 23, 23, 25, 25, 25, 26, 26, 26, 28 mm.  
=23.6 mm.

♀ 18, 21, 22, 23, 23, 24, 24, 24, 24, 25 mm.=22.8 mm.  
Plate XX, figs. 3-5.

## HESPERIDAE

### 6. *Eudamus galapagensis* n. sp.

Male: Head brownish, with some yellowish-white scales which predominate ventrad; Antennæ strongly hooked, dark smoky brown, indistinctly annulate with white towards the base, hook of antennæ tawny below; labial palpi with distal joint dark brown; thorax greenish olive with long hairs; abdomen blackish with purple tinge and with pale yellowish or yellowish-green scales, numerous ventrad and along the edge of the segments. Legs brownish with purple reflections, and with long hairs of lighter color. Length of body 16 mm. *Above*.—Wings dark brown with a slight greenish-olive gloss and enclosing the small yellowish-white diaphanous spots arranged as follows: three small ones before apex, *i. e.*, one subquadrate at base of and on each side of Sc.<sub>4</sub>, the third which is subtriangular, at base of SC<sub>5</sub>, and beyond the others; two small rather elongate ones, one on either side of the costal vein and situated at about the middle of the wing. Immediately below these two is a larger spot in the middle of the discal cell. Outwardly below in cell M<sub>2</sub> is a still larger subrectangular spot. This is the largest spot. In the outer third of cell M<sub>1</sub> is a square spot not extending half way down to the submedian nervure. Inside the middle of cell M<sub>3</sub> is a large rectangular spot exteriorly sinuate. The three spots before the apex and those in cells M<sub>1</sub> & M<sub>3</sub> are in line. Fringes pale brown, brownish black from nervures. A fine double, blackish brown line on edge of wings. Secondaries without spots; with a short slightly curved and tapering tail of a blackish brown color, its basal hairs long and greenish. Under a lens, the nervures are largely metallic purple.

*Below*.—The spots are repeated on the primaries. A rather obscure, lilac marginal band, becoming obsolete at anal angle; a lilac patch with some pale blue scales from the end of discal cell and in the discocellular area. No markings on space overlapped by secondaries. Secondaries blackish brown, with a basal, mesal, extradiscal and marginal band of lilac, tinted with pale bluish scales, these bands reducing the ground to two somewhat narrower bands and a spot near the base of the wing. The extra-discal (=submarginal) lilac band is curved, especially where it disappears at the tail where it becomes almost whitish. There are a number of pale straw yellow scales on the secondaries, fewer on the primaries. Expanse 43 mm., length of tails (exterior measurement) 6.25 mm.

Female: Like the male, but with broader tails, 5 mm. long and about straight, no costal fold on primaries, expanse—46 mm. (Tagus Cove, March-April, 1906).



In some specimens, the diaphanous spots are smaller and the lilac bands on the underside tend more to a pale bluish or lavender, or rarely are replaced by lighter brown or yellowish scales. The insect much resembles *E. santiago* but is not quite so dark as that species and the spots, similarly disposed, are usually larger. Below, the pattern agrees rather closely with that of *santiago*, but the latter replaces the lilac of *galapagensis* with purplish. The purplish and pale scales are in smaller proportion in *santiago* and the tails of the latter are longer.

Type 1 ♂ (Chatham Island 700 ft. altitude, October 15, 1905), and 1 ♀ Tagus Cove, March-April, 1906, Galapagos, in possession of the California Academy of Sciences. Cotypes, 1, Phil. Acad. Sci.; 10, Cal. Acad. Sciences.

One pupa of this butterfly found lying exposed on the ground at Banks Bay, Albemarle Island, in April, 1906. Pupa: Of the usual stout *Eudamus* form; rugose under a lens, pale brown speckled with darker brown, a brown stripe above the spiracles. Head very nearly as wide as thorax, not very convex on vertex giving it a square aspect. Cremaster darker brown, rounded at extremity, excavate ventrad. Length 16 mm., width at shoulders 5 mm. Pupa preserved in spirits.

This is a common Skipper, especially on Chatham and Albemarle Islands, appearing quite early in the season, being rather distinctly double-brooded, the first flight beginning in January or thereabouts, while the butterfly again makes its appearance in the dry season, in about August. Seasonal conditions often vary somewhat on different islands and different slopes of the group, and this makes it rather difficult to determine the number and time of appearance of the insects there. The seasons then are not strictly contemporaneous in the Archipelago. During April, 1906, the skipper was fairly abundant at Bank's Bay (Albemarle), and half- to full-grown larvæ were found feeding on a trifoliate leguminous annual; the larvæ making a sort of nest for themselves with the leaves after the manner of other members of the genus. The butterfly has a swift flight, and when it occurs in the dry and almost barren lava beds (as it frequently does), it likes to alight in the shade of some projecting piece of rock. Such localities,



were parts of South Albemarle Island and Cowley Mountain, on the same island.

*E. galapagensis* was also secured on the Albatross Expedition in 1888, but in too poor condition to be described; it is also reported by A. Agassiz. There are ten specimens in good and fair condition in the U. S. National Museum, labeled Hood, Chatham, and Duncan Islands, Galapagos, 1891, and a series was also taken on the Hopkins-Stanford Expedition in 1898-9. It is not improbable that other expeditions also secured it.

Thirteen specimens were taken on the California Academy of Sciences Expedition, one of these being in possession of Dr. H. Skinner to whom it was referred. The specimens are from Chatham, Albemarle, and Charles Islands, others seen but not taken on James, Indefatigable, and Duncan Islands.

Expanse: ♂ 37, 38, 40, 40, 41, 43, 43=40.3 mm.

♀ 42, 45, 46, 47, 48=45.6 mm. Plate XX, fig. 6.

## HETEROCERA

### SPHINGIDAE

The following are the Hawk-Moths known to occur in the Galapagos Archipelago:

*Triptogon lugubris* Linn.

*Deilephila lineata* Fabr.

*Theretra tersa* Linn.

*Dilophonota ello* Linn.

*Dilophonota obscura* Fabr. var. *conformis* Roth. and Jordan.

*Phlegathontius rustica* Fabr. form *calapagensis* Holland.

*Phlegathontius rustica* Fabr. var. *nigrita* Roth. and Jordan.

*Phlegathontius leucoptera* Roth. and Jordan.

*Phlegathontius cingulata* Fabr.

#### 1. *Triptogon lugubris* Linnæus, Mant. Plant 537, 1771.

The specimens are somewhat smaller than the continental examples with which I have compared them, otherwise they cannot be said to differ from the latter.

Abbot and Smith's description of the mature larvæ of this insect, as quoted by Morris in his "Synopsis of the Described Lepidoptera of North America" reads: "Head dark green, with a yellow frontal band. Body pale green, with vascular dark green dashes, and a dark green subdorsal line bordered

beneath with whitish; nine short lateral, pale yellow bands; horn dark green; stigmata reddish." This description answers well for the ordinary form, but many of the Galapagos specimens (and probably from elsewhere as well) are blotched obliquely with chocolate brown from the subdorsal line laterad, from segments 6-10 inclusive. The thorax, a part of segment 5, and segments 10 and 11, have also patches of the same color.

Larvæ were observed in several instars at Iguana Cove, Albemarle Islands, March 17-21, 1906, feeding upon *Cissus sicyoides*, one of the *Vitaceæ* which flourished in that locality. The pupa is rather dark reddish brown, with the head-case obtusely rounded, and the cremaster quite stout. By digging in the loose mouldy soil near some rocky barrier, a living pupa and several pupa shells of *lugubris* were obtained.

The moths were observed on the wing, at Iguana Cove, in March, 1909, as flown specimens, the second brood coming out in April and May, the pupal period for this brood evidently being of short duration.

The insect is rather partial to the more tropically-clothed portions of the islands, as the "Green Zone" of the mountains, and those littoral areas where fairly fresh water stands and which harbor a somewhat luxurious vegetation, including its food plant.

*Triptogon lugubris* was observed most plentifully at Iguana Cove, whence it was found to extend along the coast to Villamil, thirty miles to the west. At the latter place, several specimens were taken at the flowers of *Cordia lutea* in the bright sunshine, where they were comparatively slow in their flight. However, high up on the dreary rain-sodden and vine-covered slopes of South Indefatigable Island, this little sphinx might be seen now and then flying with great speed and with a loud humming noise over the subtropical vegetation, pausing but rarely to plunge out of sight into a large convolvulaceous flower, but before you can scramble to it net in hand, it is skimming far up the mountain side. During April and May, the moth was several times observed flying low over the sandy shores below Villamil settlement, Albemarle Island, and darting

out to sea, being also seen from the schooner "Academy" which was at anchor over a mile from shore.

*Lugubris* was observed on the higher portions of Indefatigable Island (November, 1905), Albemarle (March, April and May, 1906), while an old pupal shell which seemed referable to this species, was found high up on Charles Island (June, 1906). It is a common insect in the American tropics.

There is some variation in color among the ten examples taken, the scallops of the wings seem deeper than in some specimens from Florida with which I compared them.

Galapagos—Alar expanse. ♂ 49, 53, 63 mm.=55 mm.

♀ 53, 53, 58, 60, 60, 60, 63 mm.=58.1 mm.

Florida—Alar expanse. ♂ 60, 62, 62 mm.=61.3 mm.

♀ 72, 78, 79 mm.=76.3 mm.

The three smallest ♀ ♀ from the Galapagos were reared, which probably accounts for their size. There are several larvæ and one pupa preserved in spirits.

## 2. *Deilephila lineata* Fabricius, Syst. Ent., 541, 1775.

The "White-lined" Sphinx, which is by no means the commonest of the Hawk-moths of the islands, has heretofore been collected in the Galapagos, by the Albatross Expedition (1887-88), which secured one male from Charles Island. Of the five specimens secured by me in 1906, three were reared from larvæ; and the series when compared with *lineata* from Shasta county, California, averages considerably smaller in size.

*Lineata* larvæ were found at Wreck Bay, Chatham Island (February 20, 1906), where the two-color forms were observed; on Charles Island in early March, as less advanced in growth than on the preceding island; and at Tagus Cove, Albemarle Island, in late March, when many of the caterpillars had already pupated.

Adults were observed in March (Charles Island), and at Villamil (Albemarle Island), in early May, and in both cases, in the early afternoon. The insect is certainly double-brooded and probably triple-brooded in the Galapagos; a small per cent of the late insects probably passing the dry season as pupæ.

Distribution: Charles, Chatham, and Albemarle Islands, and probably elsewhere in the Archipelago. It occurs also in the Hawaiian Islands, and is the best known North American

Hawk-moth. Also reported by Holland, and Rothschild and Jordan, from the Galapagos Islands.

There are several larvæ and one pupa of *lineata*, from the Galapagos, preserved in spirits.

Galapagos—Alar expanse. ♂ 51,<sup>1</sup> 67 mm.=59 mm.

♀ 62, 67,<sup>1</sup> 78<sup>1</sup> mm.=69 mm.

California, U. S.—Alar expanse. ♂ 77, 78, 79, 88 mm.=80.5 mm.

♀ 90, 96, 98, 101 mm.=96.2 mm.

### 3. *Theretra tersa* Linnæus, Mant. Plant., II, 538, 1771.

This handsome insect appears to be still rare in the islands, the only specimen secured being reared from a larva discovered by lamplight, feeding upon the leaves of *Clerodendron molle*, Chatham Island, February 23, 1906.

The larva of *tersa*, which is of the "Hog" caterpillar type, has several times been described, while the pupa corresponds well to Hy. Edwards' description of it in *Entomologica Americana*, III, 164, 1887. The pupa was formed in a shallow depression in the soil, and sheltered by a leaf or two.

This sphinx may be a recent arrival to the Galapagos Archipelago, judging from its rarity there, and from the fact that it was taken only from the most windward (except Hood Island) island of the group, viz., Chatham. It does not differ from continental specimens, which are quite common in the Tropics.

One Male—Wreck Bay, Chatham Island, altitude 500 feet, February 23, 1906.

Alar expanse, 66 mm.

### 4. *Dilophonota ello* Linnæus, Syst. Nat., 491, 1758.

This species was found quite plentifully on Charles, Chatham, and Albemarle Islands.

Imagines were taken at flowers on the three above-named islands, during the rainy season. The first larva taken, was found at the base of a Guava tree (*Psidium*), on Chatham Island, January, 1906. It pupated a short time after its capture. Small specimens of the larvæ were observed at South Albemarle, in early March, 1906, and in numbers at Iguana Cove, a few days later. The food plant of *ello* is *Hippomane*

<sup>1</sup> Ex larva.

*mancinella* (a poisonous tree, which is common along the shores), and *Psidium*. At Iguana Cove, the larvæ were observed in several instars and were either of a pale sea-green or reddish-brown color, as described by Edwards, Holland, and others. The larva has a habit of stretching itself appressed to a twig, and is thus often difficult of detection. The pupa has been well described by Edwards (*Ent. Americana*, III, 167, 1887), and a number of these prettily striped objects were found beneath *Hippomane* trees (Iguana Cove), by disturbing the loose mouldy soil and by overturning pieces of lava.

*D. ello* is an exceedingly abundant insect in the American tropics and occasionally ventures well up into the temperate latitudes of North America. It is also recorded from the Galapagos Islands by Rothschild and Jordan.

There are nine ♂ and eight ♀ in the Academy's collection, besides three pupæ and several larvæ preserved in spirits.

Alar expanse: ♂ 67, 70, 71, 72, 72, 73, 73, 74, 78=7.22 mm.

♀ 72, 72, 74, 76, 78, 79, 82, 91=78 mm.

##### 5. *Dilophonota obscura* Fabricius, *Syst. Ent.*, 538, 1775.

Subsp. *conformis*, Rothschild and Jordan, *Novitates Zoologicae*, Supplement Vol. IX,<sup>1</sup> 369, 1903.

The description of the insect in *Novitates Zoologicae*, reads:

"*Erynnis obscura conformis*, subsp. Nov. ♂ ♀. Sexes similar; ♂ without a longitudinal streak on the forewing, and having the thorax as gray as ♀. Distal margin of hindwing rather darker in the upper half than in the ordinary form, and the post-discal line of dots more distinct. *Hab.* Galapagos Island, Albemarle; end of March to May, 1902 (Beck); *type*: Top of crater, S. E. Albemarle, 27, III, 1902. In the Tring Museum 4 ♂ ♂, 4 ♀ ♀."

There are 4 ♂ ♂ and 32 ♀ ♀ in the collection of the California Academy of Sciences, and there is but one ♀ among these which has the thorax as dark as in the ♂ ♂. These have the thorax slightly darker than in the ♀. The thorax of the latter sex, is nearly concolorous gray, while in the ♂, several longitudinal lines of brownish gray are evident, which are almost or entirely absent in the ♀ ♀. Quite a common insect in the Tagus Cove region, Albemarle Island, in March and April. It was easily attracted by light and a number were



taken throughout the night, at a campfire, on the mountain slope.

There were but few larvæ of this species to be found by the end of March, but the evidence of their ravages was discernible on their food plant, a species of Asclepiad vine (*Asclepias angustissima*), which was abundant at Tagus Cove, especially on lava. As in *D. ello*, there are two color forms of the larva, one being purplish gray, the other pale green. There is no pink spot on the third and fourth segments as in *D. ello*, and the anal horn is quite short.

The insect has been taken only on Albemarle Island.

Alar expanse: ♂ 56, 59, 60, 62=59.25 mm.

♀ 54, 57, 58, 58, 59, 60, 60, 60, 60, 60, 60, 60, 60, 61, 61, 62, 62, 62, 62, 62, 62, 62, 62, 63, 63, 63, 63, 64, 64, 65, 66=61.12 mm. Plate XX, fig. 11.

6. *Phlegathontius rustica* Fabricius, Syst. Ent., 540, 1775; var. *calapagensis* Holland, Proc. U. S. N. M., XII, 195, 1889 (Galapagos, Charles Island).

*Syzygia galapagensis* Kirby, Cat. Lep. Het. I, p. 685, No. 2, 1892 (Galapagos).

*Protoparce calapagensis* Rothschild and Jordan, Novitates Zoologicae, Suppl. Vol. IX,<sup>1</sup> 85, 1903 (Charles and Chatham Islands, Galapagos).

This common Galapagos Sphinx was first described by Holland, from one ♀ secured on the Albatross Expedition, in 1889. He thinks it entitled to specific rank, but Rothschild and Jordan in their great work on the Sphingidæ of the world, consider *calapagensis* a subspecies of *rustica*.

Holland's description of *calapagensis* reads:

"*Protoparce calapagensis* sp. nov. (Holland). Upper surface—Anterior wings white, traversed by double, undulate, black transverse anterior, posterior, and submarginal lines, the latter terminating near the exterior angle in a conspicuous black spot. A row of marginal black spots, those nearest the apex protracted in the form of dashes; the second from the apex coalescing with the submarginal line, further ornaments the wing. Fringes white, interrupted at the end of the nervures by black. The discal dot is pure white, large, narrowly margined with black. Upon the costa, near the base, is a black dash, followed by some confused "pepper and salt" markings near the transverse anterior line. Posterior wings gray, shading into white at anal angle, and traversed by three black bands, of which the two on the discal space are narrow, while the submarginal band is broader, widening rapidly from the anal angle toward the anterior margin. Head, antennæ, and thorax white. Patagiæ white, marked in the middle with a



deep black curved line extending from the insertion of the anterior wings about two-thirds of their length. Abdomen light gray, almost white, ornamented by two large tufts of black hair at base, and by a narrow dorsal line consisting of a black dash upon each segment. Each segment is further margined by a transverse line of black at its insertion, and the second, third, and fourth are marked by lateral spots of pale yellow surrounded with black.

Under Surface—Palpi, thorax, and abdomen snowy white. Upper ends of tibiae and tarsi light brown, ringed with white. Wings gray, obscurely marked, and banded as on upper surface. Expanse of wings, 90 mm.

Described from one female specimen in fair condition, labeled 'Galapagos, Charles Island.'

#### Rothschild and Jordan's description:

"♂ ♀ smaller and paler than *Rustica rustica*. The tenth abdominal tergite of the ♂ not so distinctly sinuate, and harpe shorter than in *Rustica rustica*, otherwise the same. In Tring Museum 2 ♂♂, 2 ♀♀, Chatham Island, 14, III, 1901 (R. H. Beck); Charles Island (Markham)."

The insect is quite variable, the female described by Holland, is evidently a pale specimen, while the sphinx referred to by him as being "too badly worn to permit of a proper description," may belong here. While some of the specimens in the California Academy of Sciences' collection, approach the var. *nigrita* R. & J. quite closely, they can be separated from it by the constant presence of the ochraceous coloration, and usually by the conspicuous yellow abdominal spots which are wanting in *nigrita*. A male *calapagensis* from Charles Island, is very heavily marked with ochraceous; in several other specimens, this color is scarcely observable; while in the duskiest individuals, the yellow abdominal spots are almost obsolete.

Mature larva—Head pale green, body paler green, roughly granulated, the granules yellowish white and most prominent on the thorax, where they are arranged in a subdorsal row with more or less scattered granules between. Seven oblique stripes of purple lake, below which are cream colored stripes; stigmata with yellow discs. Tarsi black, with one or two pale yellow granules basally; anal horn stout and curved, yellowish, roughened with tubercles. Approximate length 70 mm. Described from several well preserved alcoholic specimens.

Considerable color variation exists among these larvæ; some of them have a yellowish ground color, others are adorned with large purplish patches, while fewer are blackish purple, the head being purplish with green about the clypeus. In all cases, the granules are conspicuous and of a pale yellowish color.

The larva of typical *rustica*, differs somewhat from that of the island form, as can be seen from the following description of *rustica rustica* by Rothschild and Jordan: "Larva finely granulated, with seven side-bands, which are white and bordered green in front." The larva illustrated by Smyth in Ent. News, XI, 486, 1900, resembles much more another rarer form of larva taken, which is nearly smooth, and may or may not belong to this species, and which is described later.

The pupa is reddish brown, with a short detached tongue-case applied to the breast by its pear-shaped extremity. The tongue-case is roughened subdorsally by sharp transverse ridges. Length 50 mm.

Larva and adults of *P. rustica calapagensis* were observed at Chatham in February, 1906, the latter being rather worn, and the former in several instars, but scarcely mature (February 23, 1906). A few days later, on Charles Island, eggs and adults were secured. The height of the larva season, is March and early April, when they were to be found in numbers, at Iguana and Tagus Coves, Albemarle Island. At the latter cove, they were found up to an altitude of 3000 feet, but were commoner at lower levels, where *Cordia lutea*, one of the *Borraginaceæ* abounded. This is the most popular of its food plants, while *Clerodendron molle* (*Verbenaceæ*) appeared to replace it as a food-plant, on Charles and Chatham; and in some localities on Albemarle, the large arboreal *Heliotrope*, *Tournefortia rufo-sericea*, was preferred. That the caterpillar is not particular as regards its food-plant, may be further inferred from the fact that it was also found feeding on *Erigeron lancifolius*, one of the *Compositæ*, *Croton scouleri* var. *Macraei*, and *Bastardia viscosa* (*Malvaceæ*). The larva of *rustica calapagensis* was found to be more frequently parasitized than those of the other *Sphingidæ*.

Pupation took place in March and April, especially in the latter month, when pupæ could be readily obtained at Tagus Cove, by digging among the roots of *Cordia lutea*. The adults emerge two or three weeks after pupation, though a small proportion seem to remain in the pupal stage until the next rainy season. The moths were plentiful at dusk, at the flowers of *Cordia lutea*, *Clerodendron molle*, etc., and were not difficult

to net. It is widely distributed in the Archipelago as is the case with its favorite food-plant. An old pupal shell, found on the ground, among the dry leaves of *Cordia*, on Tower Island, undoubtedly belonged to this species. (About September 15, 1906.) This insect was taken on the Albatross Expedition (1889), from Charles Island. There are two males and two females in the Tring Museum, England, and taken by R. H. Beck 3-14-1901. Snodgrass and Heller took it on Hood and Albemarle (Hopkins-Stanford Galapagos Expedition). There are nine males and five females in the Academy's collection. Taken on Charles, Chatham, and Albemarle Islands.

Alar expanse: ♂ 74, 82, 84, 85, 88, 89, 89, 90, 92=85.88 mm.

♀ 82, 92, 98, 102, 103=95.4 mm. Plate XX, fig. 8-9.

6a. *Phlegathontius calapagensis* Holland.

Aberration *nigrita*, Rothschild and Jordan, *Novitates Zoologicae*, Suppl., Vol. IX,<sup>1</sup> 85, 1903.

This dark form is thus described by Rothschild and Jordan:

"A ♂ from Chatham Island in the Tring Museum is abnormal, having the body above and the wings nearly entirely brownish black, except the double series of dorsal dots on the abdomen, the stigma of the forewing and the marginal spots of both wings, which are white, besides feeble traces of white markings on both wings. The first segment of the palpus is much less extended white than in normal specimens. We call this aberrant individual—ab. *nigrita* nov."

I obtained ex larvæ, three ♀ ♀ and one ♂ of *nigrita* at Tagus Cove, Albemarle Island, end of April, 1906. These four specimens have no yellowish patches but three dirty white ones instead, the first two in the largest ♀, have a shade of brownish yellow however. The double row of abdominal white dots are more or less connected by interspersed white scales.

This form appears to be quite rare, but its presence would seem to indicate that the variable *P. calapagensis* may resolve itself into two or more species in the distant future.

Alar expanse: ♂ 82 mm.

♀ 80, 88, 100=89.33 mm.

A sphinx larva evidently that of a *Phlegathontius*, and probably belonging to *calapagensis* but differing remarkably from and rarer than the usual form of that larva, was taken by me

at Tagus Cove. The fact that this form confined itself almost entirely to devouring the leaves of *Erigeron lancifolius* (a few being also found feeding on *Croton Scouleri*), is significant. The larvæ were most plentiful from 1500 to 2000 feet elevation and were not found below 600 feet, at Tagus Cove. Their range is apparently controlled by *Erigeron*.

The following is a description of the larva :

Mature larva—Smooth; head rather rugose with scant pile, color apple green, with a basal stripe of paris green and an anterior stripe of olive green with brown; clypeus, the same color as latter stripe; ocelli green, in a brown blotch. Body stouter than in *P. rustica calapagensis*, dark green with seven oblique prune purple stripes, each with a streak of emerald green above and one of creamy yellow below, the latter bordered by duller prune purple merging into dark green and duller purple. Dorsum creamy yellow, median line green; anal flap, dark olive encircled with Paris green; anal horn stout and curved, ochre yellow, roughened with small dark tubercles. On segment 1 are two irregular rows of dorsal tubercles, in a field of dark green. Description based on several alcoholic specimens, in poor condition, and on field notes.

Judging from the description and illustration of *P. rustica rustica*, by E. E. Smyth (Ent. News, XI, p. 486, 1900), the above described insect corresponds much more to it than does the usual plainer and rough form of *calapagensis*. From this, one might be tempted to infer that the smooth form of larva is the more ancient one which is being replaced by the more omnivorous rough form. Unfortunately these two forms were not kept separate and both *calapagensis* and its aberration *nigrita* were produced from this lot. Plate XX, fig. 10.

7. *Phlegathontius leucoptera* Rothschild and Jordan, Novitates Zoologicae, Supplement Vol. IX<sup>1</sup>, p. 79, and 805, 1903, figure Vol. IX,<sup>2</sup> plate XI, fig. 2, ♀.

The description reads :

"*Protoparce leucoptera* spec. nov. (Pl. XI f. 2, ♀) ♀ Antenna very slender, faintly incrassate distally, scaling white. Body whitish grey, mixed with brown, sides of palpus near eye, a dorso-lateral patch on metanotum and first abdominal segment, bases of apical edges of abdominal tergites on sides, brown; white dorso-lateral dots of abdomen widely separate (not distinct in our unique individual); five large yellow

side-patches to abdomen, gradually decreasing in diameter, a trace of a sixth spot on seventh segment; posterior ventral angles of tergites white; abdomen below with traces of brown mesial spots. First segment of protarsus about as long as segments 2 and 3 together, with a few short spines at base, and three long ones, situated at base, in middle and at end respectively. No pulvillus. Wings, *upperside*—Forewing: greyish white; a white stigma; submarginal area shaded with brown; a brown post-discal undulate line, an oblique black apical line, and rather indistinct brown submarginal halfmoons; fringe not well preserved, apparently the white spots smaller than the brown portions. Hindwing: grey, shaded with brown, marginal area brown, a blackish, irregular, postdiscal band; between it and base four indistinct bands or lines, the most proximal broadest, situated between base and  $M_2$ . *Underside* drab grey—Forewing: disc slightly paler; grey marginal spots; a thin oblique brown apical line; scaling in front of this line grey; scattered grey scaling also along outer margin. Hindwing: paler grey, especially a broad ill-defined discal band-like space and abdominal area; distal marginal area brown, especially in submarginal area; a faint brown band between this border and cell. Length of forewing: ♀, 45 mm.

*Hab.* Chatham Island, Galapagos Islands, 14, III, '01 (Beck). Allied to *petunie* and *sexta*. The dorsum of the thorax is mutilated in the specimen."

Further description in the appendix of the same volume reads:

"Two ♀♀ from S. E. Albemarle, collected by Mr. Beck on March 26th and 27th, 1902, are rather better preserved than the specimen described and figured. The forewing bears the antemedian lines of the allied species, and three dentate discal ones, besides the postdiscal one. On the underside there are two discal lines on the hindwing, and one or two on the forewing."

I secured ex larva, two ♂♂ and three ♀♀, one ♀ being from Chatham Island, March, '06, and the remaining specimens from Tagus Cove, Albemarle Island, April 29-30, 1906. These specimens have the dorso-lateral patch on metanotum and first abdominal segment almost black, and the former patch is interspersed with pale yellow hairs in its inner corner.

Larva—Smooth, moderately stout; head somewhat rugose, rounded, about 5.5 mm. wide; segments of body with about eight transverse deeply incised folds or wrinkles. Body, pale green, with seven oblique blackish dashes running above into the furrows, bordered below by a yellow dash. Thorax, nearly plain concolorous green, feet, circled with black. A thin dorsal line and transverse streaks in the folds form a rough triangle on each segment from four to ten inclusive. Spiracles large, dusky. There is much blackish at base of legs and on segments four and five, and suggesting pen scratches. No blackish about anal claspers; horn slender curved and pointed,



reddish, and somewhat roughened by small tubercles. Length 66 mm., width about 9 mm. Described from two nearly mature, rather poorly preserved alcoholic specimens, Wreck Bay, Chatham Island, February, 1906.

Pupa of the usual form, light reddish brown, the short ridged tongue-case applied in a curve to breast, length 40 mm. The specimen is undersized.

This pale colored *Sphinx* appears to be the rarest of the genus, no adults being taken at flowers, and the larvæ were rather local and were found feeding on a low, succulent Solanaceous plant at low altitude, at Wreck Bay, Chatham Island (February); Iguana Cove, Albemarle Island (March), and Tagus Cove, April 30, 1906.

Alar expanse: ♂ 90, 93 mm.=91.5 mm.

♀ 74, 94, 98 mm.=88.7 mm. Plate XX, fig. 7.

8. *Phlegathontius cingulata* Fabricius Syst. Ent., 545, 1775. *Protoparce cingulata*, Holland, Proc. U. S. N. M., XII, 195, 1889 ("Galapagos, Chatham Island"). *Herse cingulata*, Rothschild and Jordan, Novitates Zoologicae, Suppl. Vol. IX<sup>1</sup>, p. 10 & 11, 1903 (Galapagos).

The "Pink-spotted" Hawk-moth is by far the commonest and perhaps the most widely distributed sphinx in the Archipelago, having been taken by several of the previous expeditions to these islands.

In common with several of the other Galapagos hawk-moths, *cingulata* is often seen in the daytime at flowers, and in the evening it may be taken in numbers. It flies rather sparsely before sunrise.

The Convolvulaceæ, upon which the larva of this moth feeds, are common plants in the Archipelago, and of several species, among which are *Ipomæa galapagensis*, *pes-capræ*, and *campanulata*. The larvæ present a considerable number of varieties reducible to two types, those of a green and those of a brown ground color. These two types have several vars. and intergradations. A common form is dark chocolate brown, with two dorsal stripes of straw color, and a creamy white super- and substigmatal stripe, the lower connected with the upper by eight oblique stripes of the same color, widened



basally and frequently broken. The stigmata, bordered by dark brown, are contained in the base of the oblique stripes. A number of larval varieties are described by J. A. Lintner (Proc. Ent. Soc. Phil., Vol. III, pp. 650-651, 1864).

These monstrous caterpillars occurred in great numbers on Chatham Island, in February, 1906, when the roadside in the vicinity of Wreck Bay was swarming with them. They were also plentiful at Iguana Cove, Albemarle Island, in March.

The pupa, as is well known, is remarkable for its very long recurved tongue-case.

The moths do not differ from those of the mainland, but a few of the bred specimens, perhaps owing to under-feeding, are quite small and lack much of the usual rosy tinge.

*P. cingulata* is usually considered distinct from *convolvuli* of the Old World, but like it enjoys a wide range, being very common in the American tropics and occurring also in the Hawaiian Islands. A specimen of this insect was taken by Mr. S. J. Hunter of the Expedition on Cocos Island, September, 1905.

Specimens were found on Chatham, Albemarle, and Indefatigable Islands, and it doubtless occurs on most of the other islands of the group.

Taken also on the Albatross Expedition in 1889, the Hopkins-Stanford Expedition (the specimens being in Stanford University); and also by Mr. Beck in 1901.

There are ten ♂♂ and thirteen ♀♀ from these islands, in the collection of the California Academy of Sciences.

Alar expanse: ♂ 81, 81, 82, 82, 84, 86, 88, 88, 94, 97=86.3 mm.

♀ 77, 78, 82, 87, 87, 92, 93, 93, 97, 103, 103, 105, 112=92.2 mm.

One ♀ specimen from Cocos Island=114 mm.

## CONCLUDING REMARKS

The fauna under consideration is oceanic in its character; very few of the species are wholly tropical, but are also represented in the more temperate regions (where they occur as stragglers or as well established insects) by the identical species, or the one from which they were probably derived. That this fauna, inhabiting islands situated on the equator, is not typically tropical, is quite to be expected, since the climate of the Galapagos cannot be termed tropical but rather temperate; with much aridity, that would suggest the survival of the fittest, the immigration largely of migratory forms which *de natura* must be hardy, and the elimination of more delicate and fastidious species which were not perpetuated there owing to the climate, enemies, or lack of food-plant, for it is not improbable that some fragile species once reached the Galapagos Archipelago.

With the possible exception of the Lycænid, *Cupido parrhasioides*, the rest of the species treated here are strong fliers and hardy insects, and some, as *Callidryas eubule* and *Deilephila lineata*, are widely distributed and of migratory habits, *Phlegathontius cingulata* having been caught at sea 500 miles from the nearest land (Holland).

An island of continental origin, whose fauna has not been once obliterated by some catastrophe, would contain a comparatively large number of species, since in this case there would have been no water for the species to cross over, and barring a change of climate and a long period thereafter, the flora would remain about the same as that of the mainland from which it was separated, and at least a goodly number of the insects would persist, whereas we have seen that the insect fauna of the Galapagos is very scant. The mainland, whether we consider the Mexican, Isthmian, or South American region, is undoubtedly very rich in Lepidoptera, as compared with that order as represented in the Galapagos.

The inferior size of a number of the Galapagos Lepidoptera as compared with the same species on the mainland, suggests that the climate is largely responsible for this change; and the fact that in some cases they are subspecifically or specifically

distinct from their progenitors, shows that at least some of the fauna is of considerable antiquity, and that migrations to these islands have not been frequent or often successful. Climate and environment and isolation seem to be responsible for the evolutionary changes.

The study of the fauna of oceanic islands is an excellent guide for the determination of hardy migratory forms. We find *Pyrameis huntera* also inhabiting the Hawaiian Islands; likewise the moths, *Deilephila lineata*, *Phlegathontius convolvuli* (*cingulata* Fabr.), *Agrotis ypsilon*, etc. The Hawaiian and Galapagos Islands are separated from each other by a vast expanse of ocean, yet they have some forms in common. There are only seven butterflies and seven hawk-moths known from the Hawaiian Islands, and this fauna is also comparatively meager in the Azores, Bermudas, Samoan, Friendly Islands, etc.

The almost ubiquitous *Anosia plexippus*, which is found on a number of the oceanic islands, does not yet occur in the Galapagos, although a Milkweed (*Asclepias angustissima*, Andersson), is plentiful on some of the islands.

*Utehesia ornatrix* (Arctiidæ), *Erebus odora* (whose food-plant, a large leguminous tree has probably been introduced), *Agrotis ypsilon*, *Meliopotis nigrescens* and *sinualis*, and species of *Prodenia* (Noctuidæ), are among the Galapagos insects which are familiar to many collectors in the United States and elsewhere.

Notwithstanding the fact that the flora and fauna of the Galapagos are fairly well known, there still remains an immense field for further investigation there, and the only manner in which a satisfying knowledge of the natural history of these interesting islands could be obtained, would be by residing in the Archipelago for several years, and studying the fauna in all its relations in a most thorough and systematic manner. This little paper does not claim therefore to be much more than an imperfect study of the subject; yet it is based, however, on rather ample field notes and observations by the writer himself.

TABLE SHOWING THE INSECT SEASONS AS ILLUSTRATED BY NOTES ON FOUR SPECIES OF BUTTERFLIES, GALAPAGOS ARCHIPELAGO

Season	Island	BUTTERFLY			
		<i>Callidryas eubule</i>	<i>Agraulis galapagensis</i>	<i>Leptotes parrhasioides</i>	<i>Eudamus galapagensis</i>
Dec. 1-16	Duncan	Too early	Too early, remains on summit	Rare	
" 18-20	Jervis	Moderate	Moderate	Rather rare	Few at high altitude
" 23-31	James (James Bay)				
Jan. 1-4	James (James Bay)	Moderate	Moderate	Rather rare	Few at high altitude
" 11-14	Indefatigable (South part)				
" 24-31	Chatham (Wreck Bay)				
Feb. 1-6	Hood	Very common	Common and fresh	Common and fresh	Passing season
" 8-13	Chatham				
" 20-24	Chatham				
" 26-28	Charles				
March 1-2	Charles	Common, mid-season	Common	Common, ovipositing	Common
" 5-15	Albemarle (South)				
" 17-21	Albemarle (Iguana Cove)	Common and to summit	Fairly common	Very common	Common and fresh
" 23-31	Albemarle (Tagus Cove)				
April 1-9	Albemarle (Tagus Cove)	Common and to summit	Quite common, esp. at 1500 ft.	Common	Common and fresh
" 10-16	Albemarle (Bank's Bay)				
" 18-19	Narborough	Few seen	Quite common	Fairly common	Common, Larvae and pupa found
" 24-26	Albemarle (South)				
May 1-3	Albemarle (South)	Not common, flown specimens	Rather common, passing season	Common, mid-season	Rare
" 14-17	Charles				
" 23-31	Charles				
June 1-4	Charles	No	Butterflies seen		
" 23-30	Hood				
July 1-2	Hood	Rare	Butterflies seen	Rare	Rare
" 3-8	Chatham				
" 9-10	Barrington				
" 11-24-26	Indefatigable and South Seymour				
" 28-31	James (Sullivan Bay)	Fairly common, mid-season		Rather common	Common, in season
August 1-5	James (Sullivan Bay)	Scarce	Scarce	Scarce	Scarce
" 7-8	James (James Bay)	Few, both fresh and faded	Fairly common	Common, but rather worn, hatched ova	Rather scarce
" 10-12	Albemarle (Cowley Mt.)	Rather rare, found about food plant, passing season	Fairly common, appears to be searching for place to oviposit	Fairly common	Rather rare, mid-season
" 14-15	Duncan	Moderately common larvae at high altitude	Not common	Not at summit	Rare
" 20-31	Albemarle (S. & St. Tomas)				

TABLE SHOWING THE INSECT SEASONS AS ILLUSTRATED BY NOTES ON FOUR SPECIES OF BUTTERFLIES, GALAPAGOS ARCHIPELAGO—*Continued*

Season	Island	BUTTERFLY			
		Callidryas eubule	Agraulis galapagensis	Leptotes parrasioides	Eudamus galapagensis
1906 Sept. 1-5	Albemarle (S. & St. Tomas)	Rather rare	Scarce	Fairly plentiful	
" " 7-10	Chatham				
" " 14-15	Tower				
" " 17-18	Bindloe				
" " 19-22	Abingdon		Rare	Rather rare, at 1000 ft.	
1905 " 25-30	Hood			Scarce	
1905 Oct. 1-2	Hood	Common, ovipositing	Rather rare, ovipositing	Scarce	Rare, 1200 ft.
" " 3-12	Charles				
" " 15-18	Chatham (Wreck Bay)	Common, at 1000 ft.	Rather rare	Common, passing season	Common, at 1000 ft.
" " 20-24	Barrington				
" " 24-28	Indefat. (South)	Rather rare	Rare		Rather rare
1905 Nov. 1-3	Albemarle (South)	Moderately common	Moderately common	Moderately common	
" " 5-17	Indefatigable (South)	Common and fresh, at 600 ft.	Rare		Common, mid-season
" " 18-20	Indefat. (NE.)				
" " 21-30	Indefat. and S. Seymour				

Kansas University,  
November 29, 1910.



## EXPLANATION OF PLATE XX

- Fig. 1. *Agraulis vanillæ* Linn. ♂ Old Colony Settlement, Albemarle Island, April 24, 1906.
- Fig. 2. *Agraulis vanillæ* Linn. ♂ Under surface. Tagus Cove, Albemarle Island, March, 1906.
- Fig. 3. *Cupido parrhasioides* Wallengren. ♂ Chatham Island, October, 1905.
- Fig. 4. *Cupido parrhasioides* Wallengren. ♀ Chatham Island, Oct. 1905.
- Fig. 5. *Cupido parrhasioides* Wallengren. ♂ Under surface. Chatham Island, October, 1905.
- Fig. 6. *Eudamus galapagensis* Williams. ♂ Wreck Bay, Chatham Island, October, 1905.
- Fig. 7. *Phlegathontius leucoptera* Roth. and Jordan. ♀ Wreck Bay, Chatham Island. Raised from caterpillar caught March 12, 1906.
- Fig. 8. *Phlegathontius (Protoparce) Calapagensis* Holland. ♂ Light phase. Charles Island, February, 1906.
- Fig. 9. *Phlegathontius (Protoparce) Calapagensis* Holland. ♂ Dark phase. Tagus Cove, Albemarle Island, April 12, 1906.
- Fig. 10. *Phlegathontius (Protoparce) Calapagensis* aberration *nigrita* Roth. and Jordan. ♂ Tagus Cove, Albemarle Island, April 12, 1906.
- Fig. 11. *Dilophonota obscuris Conformis* Roth. and Jordan. ♂ Tagus Cove, Albemarle Island, March, 1906.